Low-Emission Surface Preparation/Depainting Technologies and Aliphatic Isocyanate Free Coating Alternatives

NASA Corrosion Technology Testbed

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Headquarters National Aeronautics and Space Administration (NASA) chartered the Acquisition Pollution Prevention (AP2) Office to coordinate agency activities affecting pollution prevention issues identified during system and component acquisition and sustainment processes.

The primary objectives of the AP2 Office are to:

- Reduce or eliminate the use of hazardous materials (HazMats) or hazardous processes at manufacturing, remanufacturing, and sustainment locations.
- Avoid duplication of effort in actions required to reduce or eliminate HazMats through joint center cooperation and technology sharing.

Projects are divided into two Joint Test Protocols prepared by International Trade Bridge, Inc. in conjunction with the NASA AP2 office.

- Validation of Alternatives to Aliphatic Isocyanate Polyurethanes
- Validation of Low-Emission Surface Preparation/Depainting Technologies - Alternatives to Coating Removal Methods Currently Used On Structural Steel

NASA Corrosion Technology Testbed through the USTDC contract at Kennedy Space Center is tasked to perform the necessary screening and laboratory tests for each project as outlined in the respective JTP's. The field evaluations will be performed at Stennis Space Center, Mississippi, under the oversight of the Project Engineer.

KSC Beach Atmospheric Corrosion Test Site

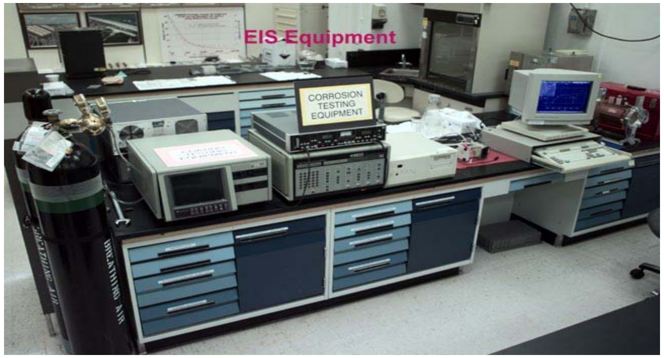
NASA Corrosion Technology Testbed

MISSION:

- To develop corrosion control and detection technologies.
- To investigate, evaluate, & determine material behavior in corrosive environments

FACILITIES-CAPABILITIES:

- •Atmospheric exposure site
- •Electrochemistry lab
- •Seawater immersion system
- •Coatings application lab
- •Accelerated corrosion equipment
- •Website (http://corrosion.ksc.nasa.gov)



Validation of Alternatives to Aliphatic Isocyanate Polyurethanes

Hazardous Material Target: Isocyanates used in polyurethane coatings.

Isocyanates are compounds containing the isocyanate group (-N=C=O). They react with compounds containing active hydrogen atoms. Thus, they readily react with water (humidity) alcohols, amines, etc. When a diisocyanate reacts with a primary, secondary, or tertiary alcohol, a carbamate group is formed, which is commonly referred to as a urethane. Rx's involving a diisocyanate and a polyol result in the formation of cross-linked polymers – polyurethanes. Hence, diisocyanates are used in polyurethane foams, thermoplastic elastomers, spandex fibers, and the polyurethane paints used in NASA and AFSPC applications.

Isocyanates are classified as potential human carcinogens and are known to cause cancer in animals.

The Occupational Health & Safety Administration (OSHA) states that the effects of isocyanate exposure include:

- irritation of skin and mucous membranes
- chest tightness
- difficult breathing

Effects of overexposure:

- occupational asthma (leading cause)
- lung problems
- irritation of the eyes, nose, throat, and skin.

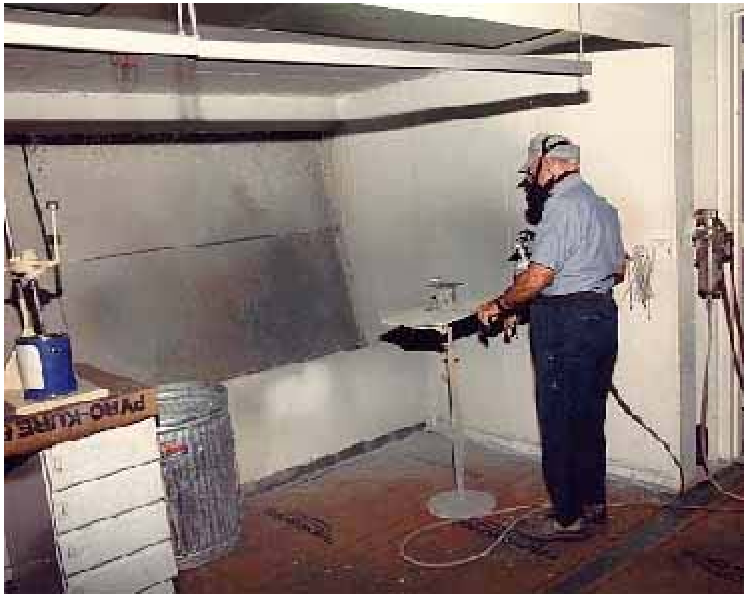
OBJECTIVE

The objective of this project is to evaluate and qualify the replacement candidates using the specifications for the existing coating systems. This project will compare coating performance of the proposed alternatives to existing coating systems or standards. The tests described in this JTP are in the following main categories:

- screening tests
- laboratory tests
- field evaluations

SCREENING TESTS

A replicate matrix of test coupons will be prepared using the candidate coatings and existing coatings as a control. Preliminary screening tests will be performed on the candidate coating systems. Candidate coatings that do not meet the requirements of the JTP will be eliminated from further testing unless otherwise directed by the testing authority. All passing candidate coatings will undergo laboratory and field testing.



Coatings Application Laboratory

Aliphatic Isocyanate Urethane Potential Alternatives

Product	**Type of System**
Ameron PSX 1001	Single Pack Acrylic Polysiloxane
Hempel Hempaxane 55000	Two-Part, High Solids Polysiloxane Enamel
International Interfine 979	Two-Part, High Solids Inorganic Polysiloxane
Jotun Jotacote PSO	Two-Pack Polysiloxane Topcoat over Epoxy
Carboline Carboxane 2000	Two-Part Modified Siloxane Hybrid
Tego Silikoftal ED	Two-Part Epoxy-Silicone Hybrid
Sherwin Williams Polysiloxane XLE	Two-Part, High Solids Epoxy Siloxane
IPN- FlexFair	Interpenetrating Polymer
IPI- Superbarrier	Interpenetrating Polymer
Kimetsan AST D45	Waterborne Coating
Sherwin Williams Centurion	Water Based Urethane
Sherwin Williams Sher-Cryl HPA	One Component Acrylic
Sherwin Williams Fast Clad HB	One Component Acrylic
MEGAFLON	Fluorocarbon Coating
Carboline Carboxane 950	Fluorourethane

SCREENING TESTS

TEST	REFERENCE
Pot Life (Viscosity)	ASTM D1200
Ease of Application	ASTM E376
Surface Appearance	ASTM D523, D2244
Accelerated Storage Stability	ASTM D1849
Dry-to-Touch	N/A
Cure Time	ASTM D4752
Cleanability	MIL-PRF-8328D, -85285
X-Cut Adhesion	ASTM D3359
Tensile Adhesion	ASTM D4541
Knife Test	FED-STD-141

LABORATORY TESTS

TEST	REFERENCE
Removability	ASTM D1200
Repairability	ASTM E376
Abrasion Resistance	ASTM D523, D2244
Gravelometer	ASTM D1849
Fungus Resistance	N/A
Accelerated Weathering	ASTM D4752
Filiform Resistance	MIL-PRF-8328D, -85285
Mandrel Bend Flexibility	ASTM D3359
Marine Exposure Environment	ASTM D4541
Cyclic Corrosion Resistance	FED-STD-141
Hypergol Compatibility	KSC MTB-175-88, NASA-STD-6001
LOX Compatibility	NASA-STD-6001

FIELD EVALUATIONS

(Performed at Stennis Space Center)

TEST	REFERENCE
Ease of Application	N/A
Surface Appearance	ASTM E523, D2244
Dry-To-Touch	N/A

Summary

The primary objective of this effort is to demonstrate and validate alternatives to aliphatic isocyanate polyurethanes. Successful completion of this project will result in one or more isocyanate-free coatings qualified for use at AFSPC and NASA installations participating in this project.

Validation of Alternative Low-Emission Surface Preparation/Depainting Technologies for Alternatives to Coating Removal Methods Used On Structural Steel

Hazardous Material Target: Airborne Particulates and Quantities of Contaminated Particulate Matter

- Many of the abrasive media currently used across NASA and AFSPC installations generate large quantities of fugitive particulate emissions and waste.
- Efforts to contain emissions and reduce the quantity of waste generated have significant implications on project cost.
- The high quantities of airborne dust and waste generated from these operations pose significant environmental concerns.

Alternative Low-Emission Surface Preparation/Depainting Technologies

OBJECTIVE

This project will identify, evaluate, and approve alternative surface preparation technologies for use at NASA and AFSPC installations. Materials and processes will be evaluated with the goal of selecting those processes that will improve:

- corrosion protection at critical systems
- facilitate easier maintenance activity
- extend maintenance cycles
- eliminate flight hardware contamination
- reduce the amount of hazardous waste generated.

Alternative Low-Emission Surface Preparation/Depainting Technologies

The tests described in this JTP are in the following main categories:

- field demonstration and evaluation
- laboratory tests

FIELD DEMONSTRATION AND EVALUATION

Field evaluations are intended to compare the performance of candidate test surface preparation/depainting technologies with current surface preparation/depainting systems when applied in an operational environment. Coating removal evaluators will complete a written evaluation and documentation checklists to organize and quantify the observations of coating removal technology performances under actual operating conditions. Candidate coating removal technologies that meet the requirements of the field demonstrations will be submitted to the laboratory tests for a more comprehensive evaluation.

AP2

Alternative Low-Emission Surface Preparation/Depainting Technologies

Surface Prep/Depainting Potential Alternatives

Product	**Type of System**
Composition Materials- PLASTI-GRIT	Plastic Abrasive
US Technology Corp- Quickstrip	Recyclable plastic media
US Technology Corp- Magic	Recyclable plastic media
Universal Minerals- MaxxStrip	Magnesium Sulfate Abrasive
Universal Minerals- Sofstrip	Sodium Bicarbonate Abrasive
BOSS Blast	Sodium Bicarbonate Abrasive
Starch Media- Corn	Corn Cob Grit
ADM/Oglive- EnviroStrip XL	Corn Hybrid Polymer Media
Starch Media- Wheat	Crystallized form of Wheat Starch
ADM/Oglive- eStrip GP	Starch Graft Acrylic Polymer Media
ADM/Oglive- eStrip GPX	Starch Graft Acrylic Polymer Media
ColdJet Dry Ice Blasting	CO2
Sponge Jet- Sponge Blasting Systems	Water-based Urethane-Foam Cleaning Media
US Technology- Sponge Blast	Aluminum Oxide Embedded in Sponge Granules
UHPWJ	Ultra High Pressure Water Jetting

FIELD DEMONSTRATION AND EVALUATION

TEST	REFERENCE
Ease of Use	N/A
Coating Strip Rate	N/A
Surface Cleanliness	SSPC-VIS 1
Surface Profile	NACE RP 0287
Waste Generation	N/A
Particulate Generation	N/A
Substrate Damage Appraisal	N/A
Warping/Denting	N/A
Metal/Composite Erosion	N/A

LABORATORY TESTING

TEST	REFERENCE
Surface Cleanliness	SSPC-VIS 1
Surface Profile	NACE RP 0287
Substrate Damage Appraisal	N/A
Warping/Denting	N/A
Metal/Composite Erosion	N/A

SUMMARY

Materials and processes will be evaluated with the goal of selecting those processes that will improve corrosion protection on critical systems, facilitate easier maintenance activity, extend maintenance cycles, eliminate flight hardware contamination and reduce the amount of hazardous waste generated.

Thank you

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